

Articles

Prospective Evaluation of the Safety and Efficacy of Laparoscopic Jejunostomy

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We prospectively assessed the safety and efficacy of laparoscopic jejunostomy done by 11 surgeons in 8 medical centers using the T-fastener technique. In all, 23 men and 13 women aged 19 to 84 (mean, 59) years required enteral feeding, but could not undergo gastrostomy and had no contraindication to laparoscopy. Of these patients, 12 had head and neck cancer and 11 had neurologic swallowing dysfunction. The procedure took 25 to 180 minutes (mean, 75). Three (8%) early cases were converted to open jejunostomy because of accidental enterotomies caused by inappropriate techniques that were avoided in later cases. Minor technical problems, such as passing a needle through the back wall of the jejunum, occurred in 7 patients, but they were easily corrected and produced no complications. Feedings were routinely begun within 24 hours of the surgical procedure. All jejunostomy catheters functioned well. This is a safe and effective technique when done by experienced laparoscopic surgeons, and serious complications are rare.

(Duh QY, Senokozlieff-Englehart AL, Siperstein AE, et al: Prospective evaluation of the safety and efficacy of laparoscopic jejunostomy. *West J Med* 1995; 162:117-122)

Jejunostomy is indicated in patients who have a functioning gut, but are unable to eat and in whom gastrostomy is contraindicated or not possible. We developed a new technique for the percutaneous placement of a jejunostomy catheter, guided by laparoscopy (laparoscopic jejunostomy), in which T-fasteners are used to retract and anchor the jejunum. Preliminary experience showed it to be safe and simple to perform.¹ We report the results of a prospective, multicenter study using this laparoscopic jejunostomy technique.

Patients and Method

In all, 36 patients were enrolled prospectively over a six-month period from eight medical centers in the United States. Patients were included in the study if they had a functioning gut and required long-term enteral

feeding because of existing or possible malnutrition and were not candidates for percutaneous endoscopic gastrostomy or laparoscopic gastrostomy or were undergoing other laparoscopic procedures. In these patients, jejunostomies rather than gastrostomies were indicated usually because of gastric abnormalities, such as gastroesophageal reflux and aspiration, gastroparesis, gastric outlet obstruction, or previous gastric resection.

Patients were excluded from the study if they had a contraindication for laparoscopy or jejunostomy, including nonfunctioning gut, pregnancy, morbid obesity, peritonitis, inflammatory bowel disease, massive ascites, a severe bleeding disorder, and severe adhesions from previous abdominal operations. The study protocol was reviewed and approved by the human research committee

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Dr Duh and Dr Way developed the procedure for creating laparoscopic enterostomy using the T-fastener technique. The Regents of the University of California hold the patent to this technique (US Patent No. 5,151,086). The Regents of the University of California have licensed Abbott Laboratories to use this patent for laparoscopic enterostomy kits. Dr Duh and Dr Way may be entitled to a share of the royalties. Drs McCamish and Ross and Ms Senokozlieff-Englehart are employees of Abbott Laboratories.

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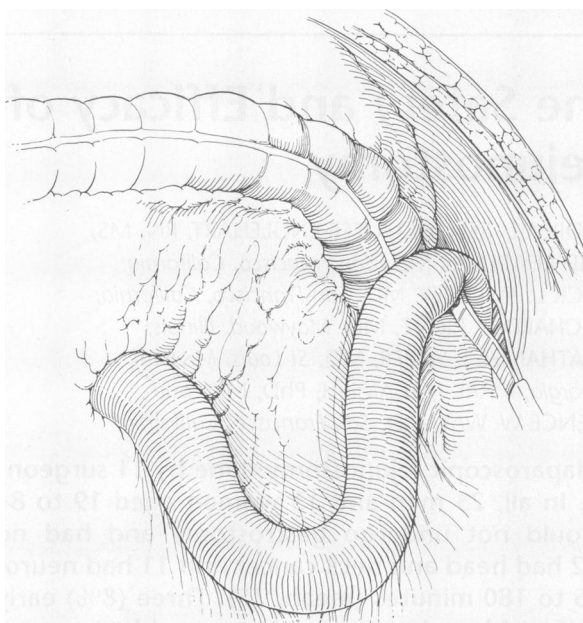


Figure 1.—The proximal jejunum and the ligament of Treitz are identified by lifting the transverse mesocolon and running the small bowel with the graspers.

of each medical center, and informed consent was obtained from each patient. One case was done with the patient under intravenous sedation; all the others were done with the patients under general anesthesia. Video recordings of the procedures were reviewed by one of the authors (Q.-Y. D.). The patients were examined by the operating surgeon after the procedure and were observed for at least two weeks. Causes for complications and conversions were analyzed after the first 25 cases and used to improve the results for the subsequent cases. The procedure was performed as previously described (Figures 1 through 5).¹

Results

There were 23 men and 13 women, ages 19 to 84 years (mean, 59 years). Of these, 12 patients (33%) had head and neck cancer, 11 (31%) had neurologic deficit,

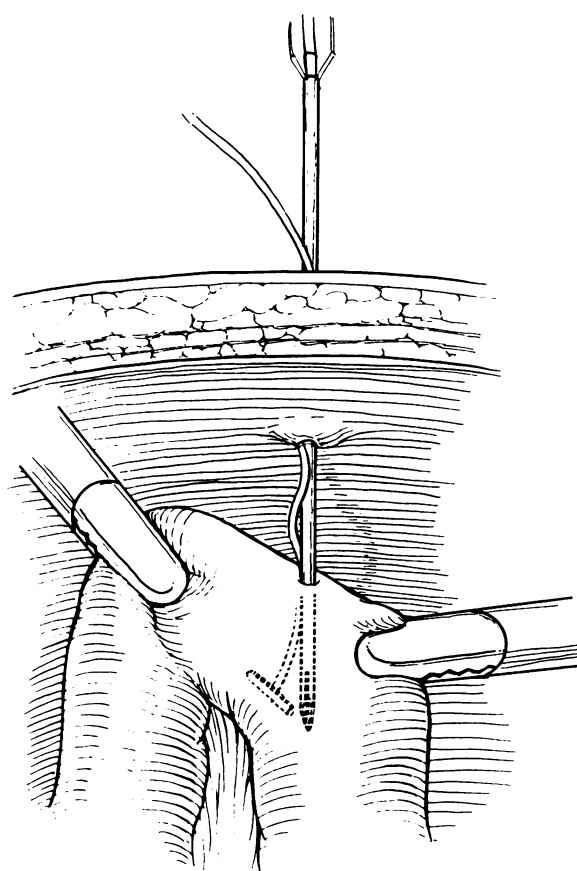


Figure 2.—The T-fastener is introduced percutaneously and discharged into the lumen from the slotted needle by the stylet. Note the oblique angle of the needle to the jejunum to avoid perforation through the back wall or into the mesentery.

and 13 (36%) had esophageal cancer and other diseases requiring jejunostomy for treatment or prevention of malnutrition. In all, 9 patients (25%) had had previous abdominal operations. Serum levels of albumin were 13 to 48 grams per liter, with a mean of 31 grams per liter (1.3 to 4.8 grams per dl, with a mean of 3.1 grams per dl). The procedures lasted 25 to 180 minutes (mean, 75 minutes). Of these, 4 were done with a concurrent laparoscopic gastrotomy.

Operative

Three cases (8%) were converted to open jejunostomy because of accidental enterotomies, one by graspers and two by the catheter (Table 1). Another patient, who had a successful laparoscopic jejunostomy, had laparotomy because of a failed concomitant gastrotomy. Other minor intraoperative problems were easily corrected without complications and did not require laparotomy. The slotted needle penetrated the back wall of the jejunum in two patients; the needle holes did not require suturing. One T-fastener had to be cut and replaced to achieve optimal placement in five patients.

TABLE 1.—Conversion, Complications, and Death in 36 Patients Who Underwent Laparoscopic Jejunostomy

Result	Patients	
	No.	%
Converted to open jejunostomy*	3	8
Postoperative complications	4	11
Volvulus required laparotomy	1	
Wound erythema or infection†	3	
Catheter dislodged postoperatively‡	5	14
Death (<30 days postoperatively)§	4	11

*One jejunal injury was caused by a grasper, two by the catheter.

†One patient required antibiotics.

‡All were replaced, two by repeat laparoscopy.

§All died of underlying diseases; the jejunostomies all functioned well.

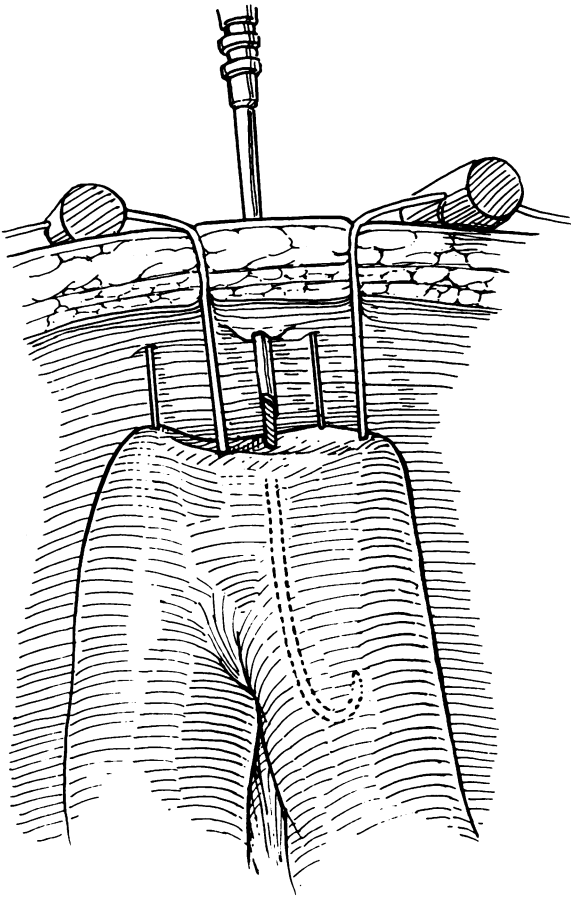


Figure 3.—Four T-fasteners are used to retract the antimesenteric jejunal wall. A J-wire is introduced into the lumen of the jejunum through an 18-gauge needle.

Postoperative

In one patient (3%), a 34-year-old woman, a volvulus developed around the jejunostomy site, requiring laparotomy one day after the procedure. In three patients (8%), local erythema developed, in two at a T-fastener site, and in one at the jejunostomy site. They were treated by removing the T-fasteners; one patient received antibiotics. Five patients (14%) required the replacement of catheters when they were removed accidentally. One was replaced in the emergency department, and one was replaced on the ward. One was replaced twice, once in the emergency department and once under fluoroscopy. Two were replaced by repeat laparoscopy (see Table 1). The jejunostomy catheters all functioned well. Episodes of clogging were few and were easily treated by flushing the catheters with saline solution.

In our study, 4 patients (11%) died within 30 days of the procedure (Table 1). A 76-year-old man with a thoracic epidural abscess died of respiratory failure 8 days after the procedure. A 74-year-old man, who had severe peripheral vascular disease and failure to thrive, died 13

days after a jejunostomy of sepsis originating from his below-the-knee amputation site. A 79-year-old man, who had an emergent aortic valve replacement, died of multisystem failure 7 days after the jejunostomy. A 46-year-old man with squamous cell carcinoma of the floor of the mouth died of disseminated cancer 15 days later at home. All of them had a functioning, nonleaking jejunostomy. Autopsies on the first two patients showed the jejunostomy to be intact.

Discussion

We recently developed a laparoscopic technique for placing catheters inside the bowel by anchoring them with T-fasteners.² We have applied this laparoscopic

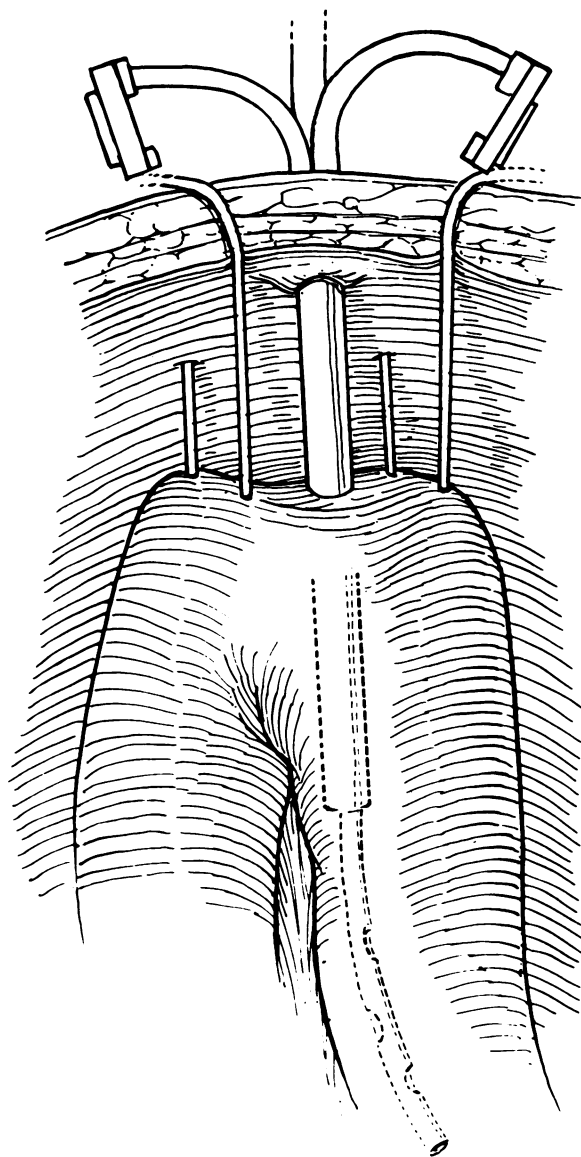


Figure 4.—The jejunostomy catheter is placed through the peel-away introducer, which is then removed.

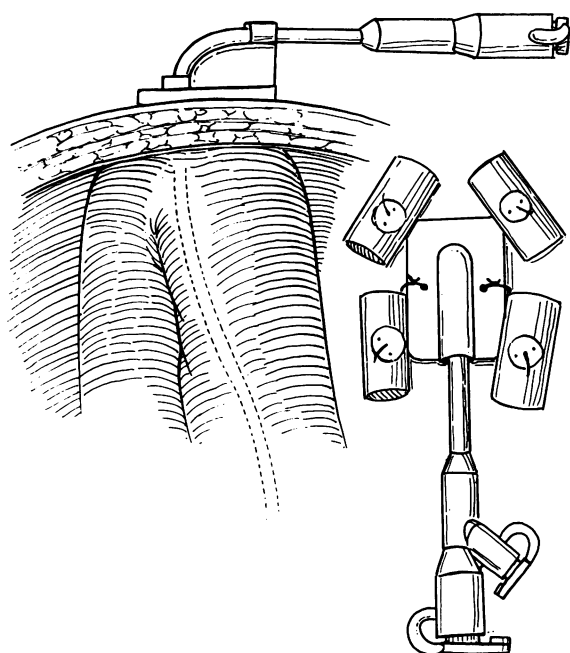


Figure 5.—The T-fasteners and the jejunostomy catheter are secured to the abdominal wall. The T-fastener sutures are cut 2 weeks later, and the metal T-bars are allowed to pass in the stool.

technique successfully to place gastrostomies,³ jejunostomies,¹ and cecostomies.⁴ This multicenter prospective study was designed to evaluate the safety and efficacy of this technique for laparoscopic jejunostomy in a large group of patients.

Three of the patients (8%) required laparotomy because of accidental enterotomies. These occurred early in the study and were the result of inappropriate techniques. One was caused by traumatic retraction on the bowel by graspers that were not designed to hold the bowel. One was caused by the forceful introduction of the catheter at a 90-degree angle through an introducer, the tip of which was against the back wall of the jejunum. One occurred in a patient with poor tissue who was receiving steroids and chemotherapy. The first two enterotomies were small and could have been closed by laparoscopic suturing without laparotomies; laparotomies were done because of our protocol requirement. Neither abdominal or wound infection developed in any of the three patients. The rate of conversion to open jejunostomy is expected to be negligible once a surgeon gains experience in manipulating the small bowel.

Because laparoscopic manipulation of the bowel requires some practice, only surgeons with advanced laparoscopic training should do laparoscopic jejunostomy. Because laparoscopic gastrostomies are easier to do than laparoscopic jejunostomies, we recommend that the surgeons gain experience first with laparoscopic gastrostomies before attempting laparoscopic jejunostomies.

Minor technical problems, such as placing the

needles through the back wall of the jejunum, also occurred in early cases and became rare with the increasing experience of the surgeons. T-fasteners can be most accurately placed if the jejunum is well distended by insufflating air through a nasogastric or orogastric tube or through the slotted needle when the first T-fastener is introduced. A misplaced T-fastener can be removed or, if it is already inside the lumen of the bowel, cut and allowed to pass with the stool. The alignment of the T-fasteners in a "diamond" pattern on the jejunum and the abdominal wall is crucial. Tension exerted by the T-fasteners because of misalignment can tear the jejunum.

The procedure time decreased as the surgeons gained experience (Figure 6). An uncomplicated laparoscopic jejunostomy should take 30 to 45 minutes. This is no more than the time it usually takes for an open jejunostomy. Laparoscopic jejunostomies have been done using only local anesthesia, although with more difficulty because the pneumoperitoneum is limited. A kit for laparoscopic jejunostomy (Flexi-Flo Lap J Kit; Ross Product Division, Abbott Laboratories, Columbus, Ohio) has been approved by the Food and Drug Administration and is priced similar to other kits for percutaneous endoscopic gastrostomies and laparoscopic gastrostomies. The cost of laparoscopic jejunostomy, therefore, may not differ substantially from that of open jejunostomy.

Volvulus around the jejunostomy site is a serious complication. It occurred in one of our patients and was corrected by laparotomy. Volvulus can also occur in patients with open jejunostomy.⁵ It is most likely caused by the small area of bowel that is fixed to the anterior abdominal wall and the mobility of the small bowel. The diamond-shaped alignment of the T-fasteners, affixing a longer portion of the jejunum to the anterior abdominal

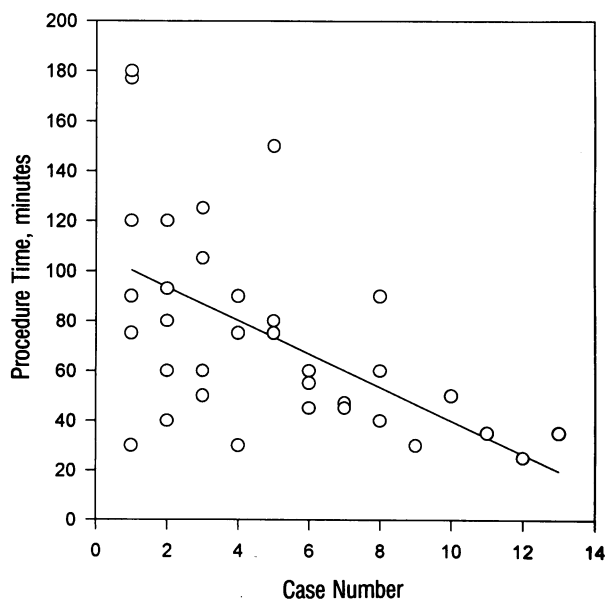


Figure 6.—The time required to do a laparoscopic jejunostomy decreases as surgeons become more experienced.

TABLE 2.—Comparison of Complications and Death in Patients Undergoing Enterostomies by Different Techniques

Enterostomy Technique	Complications, % of Patients				Reference
	Operative Complications	Tube Dislodged	Convert to Laparotomy	30-Day Mortality	
Percutaneous endoscopic gastrostomy	24	8	0	17	Jarnagin et al, 1992 ^a
Laparoscopic gastrostomy	16	9	9	3	Duh and Way, 1993 ^b ; this report
Open jejunostomy	16-46	4-24	NA	21	Weltz et al, 1992 ^c ; Cogen et al, 1991 ^d ; Smith-Choban and Max, 1988 ^e
Laparoscopic jejunostomy	11	14	8	11	This report

NA = not applicable

wall, may make the occurrence of volvulus less likely.

A jejunostomy catheter can be dislodged and cause a notable problem.⁶ The T-fastener technique appears to offer an advantage should the catheter become dislodged. Because the T-fasteners surround the catheter site, the risk of leakage and peritonitis is minimal. Because the jejunostomy site is fixed to the anterior abdominal wall, the dislodged catheter can be replaced directly at the bedside or under fluoroscopy. Two of our patients returned after their catheters were dislodged for a few days, and the tracks had closed. A second laparoscopic jejunostomy in these two patients was easier than the initial operations because the proximal jejunum was already affixed to the anterior abdomen.

Patients who require enteral feeding by gastrostomies or jejunostomies usually have severe illness, such as end-stage cancer, neurologic deficit, and cardiopulmonary diseases, and have a high rate of mortality and morbidity (Table 2).^{3,5-8} One study showed that a third of patients died within 60 days and half died within six months of the procedure, mostly of their underlying disease.⁹ Another study of patients who underwent open jejunostomy showed a mortality of 21% at 30 days; most died of cardiopulmonary diseases.⁵ Of our patients, 4 (11%) died within 30 days of the procedure. All had severe underlying diseases, and their jejunostomies were functioning at the time of death. Because the jejunostomies were not the cause of death, more stringent patient selection would have decreased the postoperative mortality.

When enteral feeding is required to treat or prevent malnutrition, we prefer doing gastrostomies. Percutaneous endoscopic gastrostomy can be done using local anesthesia and sedation. When a percutaneous endoscopic technique is not possible, we place the gastrostomy under laparoscopic guidance.³ Gastrostomy has the advantage of a reservoir for bolus feeding, and a larger catheter is less likely to kink or clog and can be replaced easily.^{8,10} We place jejunostomies in patients who have contraindications to a gastrostomy, such as gastroparesis, gastric outlet obstruction, or gastroesophageal reflux. These patients are at risk for aspiration if they are fed through gastrostomies.

Placing a jejunostomy laparoscopically using the T-fastener technique has advantages over alternative

techniques. Open (Witzel) jejunostomy requires a laparotomy, with possible wound complications and longer postoperative recovery. Needle jejunostomy also requires a laparotomy, and the small lumen of the catheter clogs easily. Percutaneous endoscopic jejunostomy, in which a jejunostomy catheter is threaded through a gastrostomy (percutaneous endoscopic jejunostomy) catheter, has been advocated by some.¹¹ Its use is associated with a high rate of failure and complications, however, and has been abandoned by many endoscopists.^{9,12,13}

Other alternative techniques have all been used successfully in a few patients. An endoscopy-assisted open jejunostomy has been described in which a long endoscope is passed to identify and "tent" the proximal jejunum. The jejunum is pulled through a mini-laparotomy incision, and the catheter is inserted.¹⁴ A laparoscopically assisted open jejunostomy also has been described.¹⁵ Other methods for laparoscopic jejunostomies require transabdominal suturing to fix the jejunum to the abdominal wall.¹⁶⁻¹⁸ An interventional radiologic technique for direct percutaneous placement of a jejunostomy catheter using the Cope gastrointestinal suture anchor has also been reported.¹⁹ The T-fastener technique is simpler to do because it requires no laparoscopic suturing or knotting and can be mastered by surgeons who are experienced in other laparoscopic procedures. It is minimally invasive and allows direct inspection of the bowel.

This prospective multicenter study showed that when done by experienced laparoscopic surgeons, laparoscopic jejunostomy using the T-fastener technique is safe and effective. Feedings can be instituted promptly, and serious complications are rare. If the jejunostomy catheter becomes dislodged, leaks do not occur, and the catheter can nearly always be replaced without a laparotomy.

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THE ACCIDENT

A dry straight road and a red Ford coupe.
 Seventy into a rock that marks
 the driveway of a man, who, mowing his lawn,
 can only open his mouth to say "no" or "watch out,"
 some word that forms a powerless O.
 He stands there. The car ticks. A child's car seat sways.
 A spot in the road, loaves of white bread
 and diapers blown into the weeds,
 and the woman wailing so
 the cats in the neighborhood disappear for days.
 Not until January will salt and the plow
 scrape up the rubber. Mud season the oil will sink.
 July they'll resurface it.

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